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[54] METHOD AND APPARATUS FOR AN INTEGRATED LASER BEAM SCANNER

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[58] Field of Search 359/198, 201, 359/202, 212, 213, 214, 220, 221, 223, 224, 225; 250/230, 234

[56] References Cited

U.S. PATENT DOCUMENTS

5,629,790 5/1997 Neukermans et al. 359/198
5,742,419 4/1998 Dickensheets 359/201

OTHER PUBLICATIONS

Daneman, M.J.; Solgaard, O.; Tien, N.C.; Lau, K.Y.; Muller, R.S. "Laser-to-Fiber Coupling Module Using a Micromachined Alignment Mirror." *IEEE Photonics Technology Letters*, vol. 8, No. 3, Mar. 1996, pp. 396-398.

Judy, J.W.; Muller, R.S. "Batch-Fabricated, Addressable, Magnetically Actuated Microstructures." *Solid-State Sensor and Actuator Workshop*, Hilton Head, South Carolina, Jun. 2-6, 1996, pp. 187-190.

Lin, L.Y.; Lee, S.S.; Pister, K.S.J.; Wu, M.C. "Self-aligned hybrid integration of semiconductor lasers with micromachined micro-optics for optoelectronic packaging." *Appl. Phys. Lett.* 66 (22), May 29, 1995, ©1995 American Institute of Physics, pp. 2946-2948.

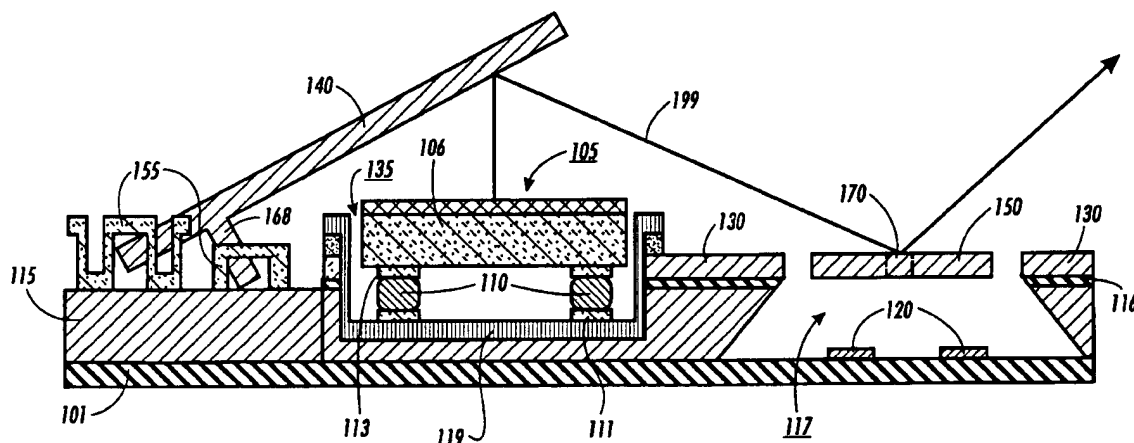
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[57] ABSTRACT

A solid state laser beam scanning system having a single crystal silicon deflection and scanning mirror integrated with a laser diode. By combining the techniques of deep reactive ion etching of silicon with solder bump bonding techniques, completed and tested laser diodes are integrated with silicon substrates supporting micro-electro-mechanical systems layers.

20 Claims, 11 Drawing Sheets



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